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Cell site analysis: Roles and interpretation

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1. Introduction – roles within cell site analysis

Call Data Records (CDRs) are generated by Mobile Network Operators for billing and network monitoring purposes. The data may also provide valuable insight relevant to criminal investigations and may be requested by those operating with appropriate legal authority within the Criminal Justice System of England and Wales (CJS). Historic Cell Site Analysis involves the analysis of these CDRs, in conjunction with other information such as survey and geographic data, to determine areas where a device may, or may not, have been at the time of call activity [1]. While the time and the cell used by a given device is amongst the data, the specific location of the device, who was using it, or what was occurring when the device was used, is not recorded in the CDRs; these are often the matters to be addressed by a practitioner. The use of CDRs at court will almost certainly require some form of interpretation (by a witness or the court) as to their meaning in the context of a case.

An analysis of the CDR in the context of a case may be presented to a court. If an explanation for data has been given, and there are other reasonable explanations that could have been given, this is opinion evidence. Only expert witnesses can give opinion evidence in the CJS, and then only in areas in which they are accepted as expert. There are rules that apply specifically to expert witnesses, for example part 19 of the Criminal Procedure Rules (CrimPR) with which they are required to comply. While the CJS is adversarial, witnesses providing technical information (whether expert or not) are independent of this adversarial process and are expected to act entirely impartially. There are rulings concerning the admissibility of expert evidence (e.g. R v Bonython, The Ikarian Reefer), and requirements of an expert are stated in The Forensic Science Regulator's "Legal Obligations" document [2], and a legal context of expert evidence is discussed in greater detail in [3]. Requirements for the admissibility of expert evidence include that:

- A lay person would not be able to form a sound judgment without the expert's assistance;
- The expert's field of expertise is sufficiently well established to pass the ordinary tests of relevance and reliability;
- The expert's opinion, even if not shared by the majority in his field of expertise, has authority because of study and experience of matters outside the jury's knowledge;
- The witness has sufficient knowledge in the subject to render his opinion of value in resolving the issues before the court.
- The witness is impartial in his or her presentation and assessment of the evidence; and
- There is a reliable body of knowledge or experience to underpin the expert's evidence

While expert witnesses may provide opinion evidence in Cell Site Analysis, there are other roles within the CJS that may also perform specific technical tasks relating to the Call Data who do not. The tasks performed by them may include reformatting of call data, presentation of the call data in map form (potentially with other sources of information such as locations of interest or traffic cameras), conducting surveys (to see where a given cell is measured serving or considered for service) or the production of reports not intended for court but to inform an investigation.

The terms ""Analyst" and "Expert" as different functions within Cell Site Analysis are widely used within the field. Use of the word "expert" within this paper means "Expert Witness" (more specifically, a witness entitled to give opinion). The title "Analyst" is used inconsistently in the

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industry. For example, some practitioners providing opinion evidence (complying with all duties required in that capacity and recognised at court as expert witnesses) call themselves an "Analyst" in their reports as it is for a court to decide whether they are accepted as an expert witness (or not). Others may define themselves as an "Analyst" with no intention of giving opinion evidence and may do so without being recognised as an expert witness. The word "practitioner" is therefore used within this paper to denote anyone performing technical activity within cellsite analysis, whether it results in opinion or not. Roles are defined within this paper in terms of activity performed by an individual (whatever their job title) and is primarily concerned with assessing whether opinion is given

For a practitioner, while not all technical evidence necessarily results in opinion (or is expert evidence) opinion evidence is always expert evidence. Any practitioner may provide written or oral evidence of a technical nature, in which case they may be expected to explain the underlying process but not posit opinion on the meaning of the findings in the context of the questions before a Court (as, if they were to do so, they would need to be accepted as an expert by the court). There is a difference between explanation of technical matters arising and opinion on what may (or may not) have been happening when the data considered was generated. Failure to recognise this difference may create confusion in understanding the type or format of evidence that a practitioner is able to give (and therefore what questions they can reasonably answer). There is a big difference between explaining the terminology contained within a CDR and assessing whether specific data is to be expected if a device was at a specific location or the user performed some form of specific activity.

Attaining fair and robust justice in the Criminal Justice System relies on the skills, knowledge, understanding and integrity of various groups. Understanding the difference between fact and opinion (and thus the boundary between the role of a practitioner giving technical evidence and an expert witness) is essential for anyone operating within this system.

In the forensic science community an important precept for any witness providing technical evidence, expert or otherwise, has always been to stay within their sphere of expertise. Within areas of "traditional" forensic science (e.g. footwear analysis) the scope of expertise has often been determined, tried and tested so that both the expert and Court are aware when they stray outside that area. However, as the complexity of evidence increases and new areas of forensic technological analysis are added to the types of evidence to be given (such as telecommunications evidence) boundaries of expertise may not yet have been defined or established. In some of these areas a practitioner, although aware of the technical aspects of their knowledge, may not be aware of the legal requirements and competencies required of a witness giving opinion that they are obliged to operate within

In this paper, we have defined "fact" evidence as presentation of data and/or observations that have been gathered by a practitioner, they are what the practitioner did or observed (and not the meaning of it): by "interpretation" we mean an attempt by a practitioner to critically assess observations in the context of other information that is relevant to the issues under consideration by the Court. We have differentiated between definition of technical terms, explanations provided as a result of complex or specialist techniques, inference of scenarios that may have generated the data and those situations where consideration of a hypothesis (potentially with alternative propositions) is carried out to provide opinion on whether the data would be expected given a specified scenario, or more likely given one scenario than another. We have defined the interpretation of the meaning of the data in the context of the case as "forensic interpretation".

It is essential in the view of the authors that the participants, the CJS and the public, recognise and understand these differences. The authors contend that on its own, expertise in the core discipline may not be sufficient to ensure that forensic interpretation is robust, balanced and the methodology is transparent. Ideally an expert will need to be able to conduct core processes for the creation of material (e.g. mapping exhibits, requiring "vocational" skills), know the processes underlying the data on which they have relied ("technical knowledge", e.g. how network data is generated or the uncertainties inherent to different sampling methods for surveys), construct a documented record that provides full disclosure of their work, understand and express the manner by which opinions are formed in the context of a case, including an assessment and expression of uncertainties in those opinions ("forensic interpretation"), and be competent in presenting evidence in court.

2. Cell site analysis: art, engineering or science?

Cell Site Analysis is referred to as an "art" by some and as "engineering" or "science" by others. Below are standard (Oxford English) dictionary definitions of these approaches:

- Art: "The expression or application of human creative skill and imagination".
- Engineering: "The branch of science and technology concerned with the design, building, and use of engines, machines and structures"
- Science: "The intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment".

Cell Site Analysis, while focused on the assessment of data resulting from mobile device technology, is not defined in terms of designing, building or maintaining the technologies which produce the data. It can be defined in terms of a series of systematic technical and/or interpretive processes, with practitioners making observations following established principles. This is the description of a scientific analysis, and is the approach considered in this paper.

Ultimately, the question of whether a practitioner refers to their analysis as art, engineering or science is far less important than whether they are presenting expert evidence or not. Cell Site Analysis is technical in nature and (as there are often many possible explanations for the data) opinion is routinely required which, by definition, is expert evidence. There are tests for admissibility of expert evidence, which includes the reliability of the technique [2]; it is therefore a requirement within the Forensic Science Regulator Codes of Conduct and Practice that, for scientific or technical methods, processes must be assessed for their reproducibility, accuracy and precision [4–6]. This is possible for Cell Site Analysis if it has been approached in the manner of forensic science and is defined in terms of processes.

If a practitioner is unable to assess the reproducibility, accuracy and precision of the methods used in their approach, for example if they are undertaking analyses as an "art" rather than a 'science' (i.e. a creative exercise based on imagination rather than one based on systematic study of the data) then this may fail the admissibility test for expert evidence; if this were the case, opinion could not be provided.

3. Roles of witnesses providing telecommunication evidence

Every practitioner is expected to understand the limits of their own expertise and to work within those boundaries. These will in part be determined by a number of factors including education, qualifications, training and experience. There will, of course, be differences in the expertise of individuals in some areas which will correspond to the type and complexity of examinations undertaken. This should also be reflected in the type of evidence given, whether this is factual (presentation of data or explanation of terms) or interpretation (including provision of opinion).

The competence of any particular practitioner is a function of his/her skills, knowledge and understanding. For the purposes of this paper, the authors have defined:

- "Skills" to mean the ability to perform defined processes such as

how to normalise call data, create maps or use survey equipment. In general, such skills lead to the creation of observations and data relevant to the analysis at hand, but the results may be presented on their own merit for interpretation by others.

- "Knowledge" to mean a body of information concerning the context within which the skills are used. This could, for example, mean knowledge of the uncertainties of timings or other factors within "data" events for each network (which differ).
- "Understanding" to mean the mental processes that enable the observations to be interpreted in association with supporting knowledge within the context of the particular issues at hand.

Skills, knowledge and understanding are linked, but do not have to completely overlap. Having a skill relevant to Cell Site Analysis (e.g. producing maps) does not confer knowledge of the process by which the data in the CDR was generated. Likewise, having technical knowledge of network operation does not in itself provide the understanding required to reliably assess whether the call data would be likely given a specific scenario. It is difficult, however, to see how understanding could be gained without knowledge or skills. The relationship between these factors, and the question put before a practitioner, is at the core of this paper concerning the potential disparity between the role the practitioner is competent to fulfill and that which they may be expected to fulfill.

Skills, knowledge and understanding are acquired by education, training and experience. The first two of these three categories may be defined and regulated by formal mechanisms such as curricula, examinations and qualifications. Skills are often attained by targeted job-related training, knowledge by formal academic qualifications and relevant industry experience (with the qualifications and experience often cited by an expert to be accepted as such by the court). The third category of "understanding" is more difficult. Traditionally, it has been seen as something that can be measured by time spent and cases done, but there are weaknesses with this view – just because one has been doing a job a considerable period of time does not necessarily mean one is particularly good at it. There are other ways in which "understanding" can be gained with more reliable metrics, for example training in the use of interpretation models followed by competency assessment in the application of them. Accreditation (unavailable at the time of writing) may also address aspects of this potential issue, to ensure an appropriate competency framework is implemented and followed. Individual performance can also be assessed via Blind Trials, where the truth is known so that the expert's opinion can be calibrated against (a) the actual truth for accuracy and (b) other experts for precision. This has been conducted in other areas of forensic science. As always, the judiciary have a key role to play by recognising and critically reviewing the process by which the areas and type of expertise being provided by the witness is determined.

A practitioner can reasonably be expected to explain their findings and processes used. This may be a description of the terms used or lead on to a more case-specific description of the data and its meaning. In [6], the end-user requirement of a given method may be described as "Factual" (absolute information), "Technically Interpreted" (output not readily interpreted by a lay person) or "Evaluative" (opinion). The "Evaluative" and "Technically interpreted" end-user requirements both require some form of interpretation of the data.

4. Interpretation

It is the authors' contention that the varied use of the word "interpretation" has led to confusion as there are different ways in which material can be interpreted, and each of these approaches requires a different level of skill, knowledge and/or understanding. Competencies, therefore, do not necessarily transfer between each approach.

A standard dictionary definition (Oxford English) for interpret is:

1) "To explain the meaning of"
2) "To understand in a specified way"

There is a difference between:

- Explaining the meaning of a technical term
- Interpreting analytical output to elucidate the results
- Interpreting the data to provide possible explanations for it
- Interpreting the results in the light of hypotheses

4.1. 'Explaining a technical term'; (Fact)

Explanations of technical terms are not affected by changes in case circumstances. In the strictest sense of this phrase this role is limited to the verbatim recounting of standard information such as glossaries of terms or the like. For example, the definition of the term "SMST" in a given CDR as "incoming text" is not affected in any way by what the user of the device was alleged to have been doing, and is "fact" evidence.

4.2. 'Interpreting analytical output to elucidate the results'; (Technical interpretation; fact or technical opinion)

"Technical Interpretation", when applied to the wider field of forensic science, would include the situation where an analytical result is obtained which is then 'interpreted' as being a specific type of material using the data and specialist technical knowledge of the practitioner. This process was called "identification" by Kirk [7]. A typical "traditional" forensic example would be where a practitioner has prepared a sample from a suspected drugs seizure and performs a validated procedure, the results of which are characteristic of cocaine. If the practitioner is satisfied that there is no other material known to man that could produce such a result then they will conclude that the material is cocaine. Given thus, the conclusion is essentially deductive (i.e. a logically certain conclusion is possible) and not probabilistic and as such is not opinion, but can be treated as fact. Its correctness relies on the validity of the assumptions that underlie it.

Much of the activity within Cell Site Analysis concerns technical processes (e.g. normalising CDRs, geocoding data or performing surveys). These activities are predominantly skill based, and are largely unrelated to case circumstances. Technical interpretation of the output from these tasks requires awareness of the uncertainties inherent to the CDR and within all of the analytical processes applied to its analysis. This in turn requires knowledge of network design, handset operation and of the radio environment.

The uncertainties within individual call events will often be based on a set of principles or rules that may be applied in all circumstances. There may only be one reasonable explanation for the call event so, while the analysis may be technically complex, the test result will be factual (deductive) and not include opinion.

Other aspects of technical interpretation may not be addressed in this way. For example, estimating the service area of a cell will be dependent on the practitioner's knowledge and understanding of network configuration, radio wave propagation and influenced by a range of other information from technical processes to aid the analysis. There may be a difference in the estimated service area of a given cell by different practitioners. The assessment of the cell's service area would therefore be an opinion, albeit not one necessarily concerning case circumstances (as the assessment of the service area should not be dependent on where a given phone was alleged to have been at the time of its use). As case circumstances should not affect the opinion given, for the purposes of this paper we have defined this as "technical interpretation".

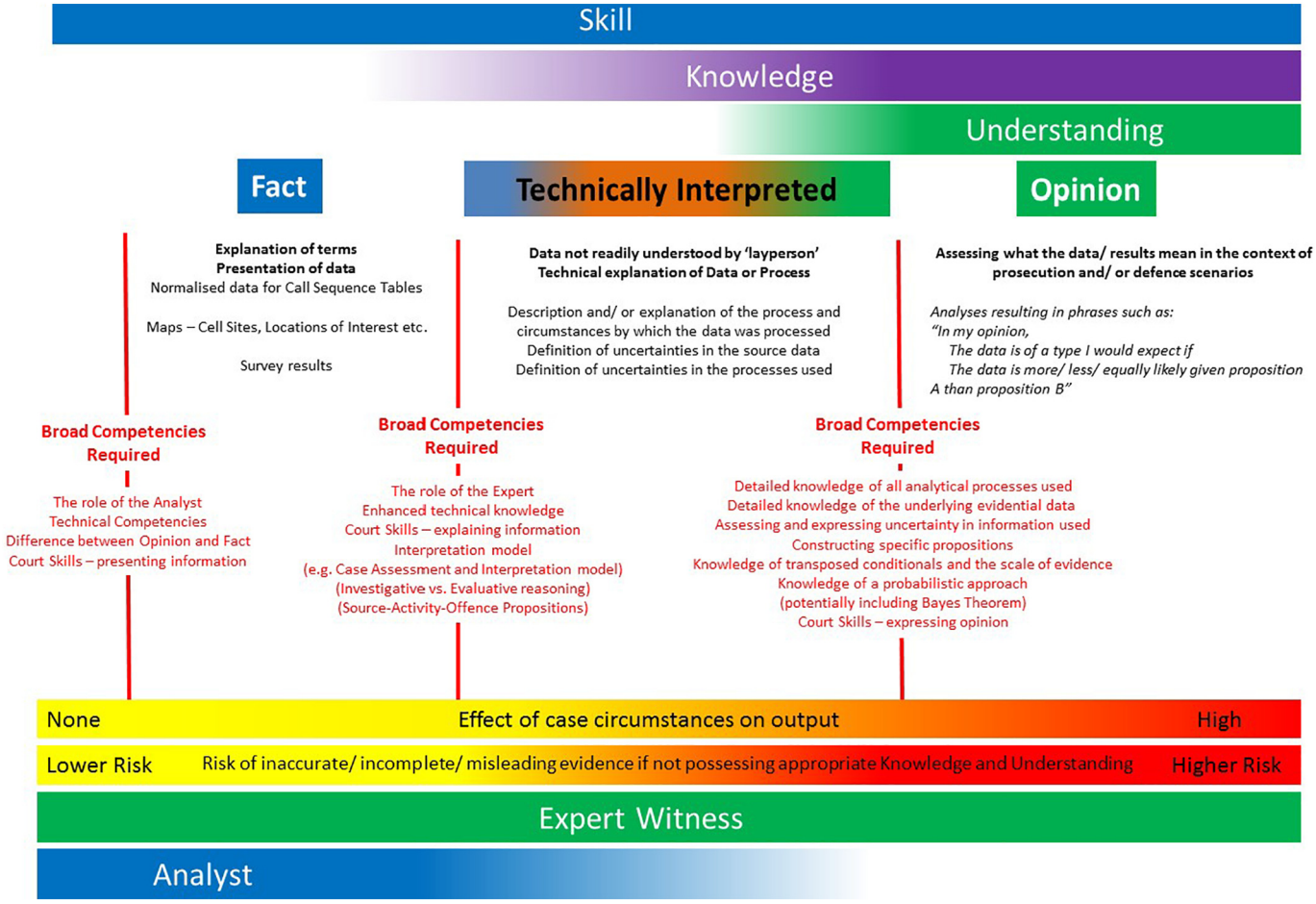

Fig. 1. Relationship between Roles.

4.3. "Interpreting the data to provide possible explanations"; (Forensic interpretation: investigative opinion)

In this role, the practitioner provides speculative explanations of their findings in the context of the case, ranked if possible, as a means of providing direction or insight. The output is provided in the form of information and explanation. This form of activity is often associated with the investigative phase of an enquiry, but assessment of this nature may be found throughout the Cell Site Analysis process including commentary of periods of call activity outside those in which specifically defined scenarios occurred. The practitioner applies their knowledge and expertise to make inferences and answer questions raised. As case circumstances may affect the opinion given, for the purposes of this paper we have defined this as a form of "forensic interpretation".

In court, the expert may be asked to present this work, describe the methods used and provide an explanation of their findings. This may include a judgment as to whether the findings can provide useful information about the activities that may have occurred (crime centred) but does not include the evaluation of a hypothesis or competing hypotheses (defendant centred). The range of possible explanations provided will depend on the knowledge and imagination of the practitioner, and there is a danger (as there may be other sources of information that could affect whether specific hypotheses is likely or not) that the practitioner can mislead. When presenting factual or technical results, it is therefore not appropriate to assert a specific level of confidence or likelihood to the findings. Any statement of confidence or probability should be limited to evaluative assessments

4.4. 'Interpreting the results in the light of hypotheses'; (Forensic Interpretation: including Evaluative Opinion)

In this role, findings are used to assess whether the data would be expected given a hypothesis or hypotheses, for example assessing whether call data would be expected if the users of devices met or if a suspect were the user of a given device. If two or more hypotheses are considered, this is called evaluative interpretation. Here we have; a framework of circumstances; a set of data; propositions that usually represent the positions taken by prosecution and defence at court. As case circumstances will affect the opinion given, for the purposes of this paper we have defined this as a form of "forensic interpretation".

The issues considered are more likely to be centred on the defendant (s) and the given propositions are usually determined by the case circumstances. The expert assesses the scientific findings in regard to scenarios presented, evaluates them impartially, enabling the formulation of an opinion and (if there are two scenarios presented) an expression of a level of support for either proposition.

There are circumstances in which a practitioner limited to fact evidence may be asked to provide a technical explanation which is beyond the definition of terms or an explanation of a process. If this explanation is constrained to presenting information that is accepted by a wider community competent to do so, this may clearly be of benefit to the court. "Common sense" explanations may apply if the uncertainties in the information are known and expressed, and a jury can reasonably make its own judgment on the meaning of the technical explanation provided without additional support; if they cannot be expected to follow the reasoning (for example if the issues addressed are too technically complex, or there are alternative possible scenarios that could

also account for the data) then it may be expert evidence and should be treated as such.

An example of a deductive conclusion from Cell Site Analysis may be the review of call data with a very large spatial distribution of cellsites to draw a general conclusion of movement of a device over a large distance for which no other reasonable explanation could apply (an example of which is given below).

5. Effect of the roles on the evidence

Please refer to Fig. 1, outlining the relationship of the different roles that a practitioner may be asked to perform. On the diagram, there are a number of factors illustrated, including:

- Skill, knowledge and understanding
- Fact, Technically Interpreted or Opinion evidence
- Effect of case circumstances on the output
- Risk of the evidence given being incorrect, incomplete or misleading if the practitioner does not possess the appropriate Knowledge or Understanding for the role in which they are acting
- The role of the practitioner

"Opinion" evidence is the province of an expert witness, but an expert can also provide technical explanations or produce "factual" material. The findings usually take case circumstances into account, and it is reasonable for a court to expect an expert to have the required skill, knowledge and understanding of the entirety of the process on which they posit opinion. This includes the methods selected (skills), the mechanisms by which the data on which the analysis was based was generated (knowledge), the transparent, robust, logical and balanced interpretation of its meaning -including an assessment and expression of underlying uncertainties - within the context of the given case (understanding). If the practitioner does not have the required skills, knowledge and understanding to do so there is a higher risk that the evidence given may be inaccurate, incomplete or misleading and fail the admissibility test for expert evidence. If, for example, an expert is accepted as such purely because of their technical knowledge of network operation but that expert relies on survey data, maps and tables to inform their opinion without appreciating the uncertainties within those processes, there is a potential hazard that the opinions expressed may be based on flawed assumptions and thus be inaccurate, incomplete or misleading. The effect of this on the reliability (and hence admissibility) of an expert's opinion is directly referenced in Criminal Practice Directions 2015 "if the expert's opinion relies on the results of the use of any method (for instance, a test, measurement or survey), whether the opinion takes proper account of matters, such as the degree of precision or margin of uncertainty, affecting the accuracy or reliability of those results" [2].

"Technically Interpreted" activities are based on the technical knowledge of the practitioner but do not necessarily require the forensic understanding necessary to safely posit opinion on alleged activity within an offence. Examples include an explanation of terms in the output (maps, tables), an explanation of a broad technical context (e.g. description of mobile networks) or a technical illustration of anticipated service area of a given cell. There is an obvious danger that, if questions become more complex or start encompassing case-specific circumstances, some practitioners may start acting in the role of an expert without having the necessary competencies, or present opinion (whether informed or not) as fact evidence.

"Fact" evidence may be reliant only on skill (these skills being "vocational" activities such as generating maps and tables) as knowledge and understanding of the wider process is not necessarily essential to, for example, present call data in map form. Case circumstances do not affect the provision of this material, which may be intended for interpretation by someone other than the producer of it. It is possible that this may be presented to the court on its own merit. There is a lower risk that the evidence given by a practitioner following an appropriately defined process requiring no interpretation of the results may be inaccurate, incomplete or misleading as long as:

i) The selection of the data that has been presented is clearly defined, logical and impartial. If only data that supports one hypothesis has been deliberately selected for presentation, (for example cellsites close to a location of interest are shown but other data in a similar period not close to the location of interest has been ignored) or the basis of selection has not been declared, the court may be misled.
ii) Those receiving the information are able to understand it. If a practitioner presents a set of maps or tables with no comment but leaves others who are not capable of safely interpreting the factual material to make their own minds up of its meaning (potentially other witnesses, lawyers, jurors etc.) the court may be misled.

A practitioner providing fact evidence should be following a "blind" process that is independent of case specific data; if they are not, this implies a level of case-specific interpretation is taking place. Some interpretation may fall within the remit of "Common Sense", so may still be acceptable by a court. Examples are provided below to enable informed debate; ultimately it is in the purview of the court to accept the testimony (or not). It is essential, however, that those using this sort of information operating within the court system understand the difference between roles, which may also be defined in terms of broad competencies. Within Fig. 1, there are a series of suggested competencies, the absence of which could be considered "barriers" between modes of operation, and of which the practitioner and court should be aware to help understanding of where evidence might be constrained.

It is common for a Cell Site Analysis expert report to switch between these modes (factual, explanatory, technical, investigative, evaluative), as a practitioner may create maps and tables, explain terms used and the context of their analysis, provide commentary of cell usage of a given device in periods when there is no scenario presented and then assess the data given a specific hypothesis or hypotheses. The dangers of treating these different types of activity in a similar manner are outlined in a series of papers by Evett et al. [8–11]. It is the view of the authors that the practitioner must understand their changing role as the language used and approach differs for each requirement, and there is an enhanced risk that there may be issues with evidence given if the differences are not understood and acted on.

6. Examples

6.1. Example 1. Interpretation of mapping

A map and table are produced by a practitioner, illustrating mast locations and locations of interest. The data in the maps and tables is an accurate reflection of the received information.

Scenario 1. There is cellsite usage over a single day, the first in central Norwich and the last in central London. The practitioner producing the maps and tables is asked to describe or explain the data, specifically if the device moved from the general area of Norwich to the general area of London

6.1.1. Version 1. The call data is for a variety of incoming and outgoing calls and text messages, with scores of cellsites used in between the two cities in an obvious sequence

The question is set in the broadest terms (i.e. the practitioner is not asked to estimate the service area of any cell used, or whether any of them encompass an area including a location of interest). In version 1 of the scenario, on the scale of a single map (illustrating Norwich and London, over 180 km apart), the icons for cellsites may be equivalent or even larger than many of the service areas' of the cells' used. As such there is a "common sense" conclusion that could be drawn that the only reasonable explanation for the data would be that the device moved

between the general areas of Norwich and London and it can (by the definition earlier in this paper) be considered deductive and be safely inferred by a "lay" person.

6.1.2. Version 2. The call data is for "data" connections on the "3" network. Only two cellsites are used, the first in Norwich, the second in London, spaced by a number of hours

Version 2 has the same "broad" question as Version 1 and is of an equivalent scale, but there is much less call data and the type of data that does exist has additional uncertainties than for voice calls and texts. CDRs for "3" data connections are not generated in the same manner as voice calls, texts or GPRS. They are recorded at 15 minute increments and are based on an identity for the handset which is unique at a local level but may not be unique at a national level. As such, the two call events may not refer to the same device. The conclusion that the device moved between the general areas of Norwich and London is not the only possible explanation for the data even though the "common sense" explanation above would seem - at face value - to apply.

The difference in the safety of drawing conclusions from each version of the scenario is not based on the skill of the practitioner in presenting the call data. The difference is based on the knowledge of the uncertainties in the underlying call data, and understanding how those uncertainties may affect any conclusions that can be drawn from it.

If the practitioner knows these differences (which is a "factual" exercise not dependant on detailed knowledge of RF propagation or other factors) then they can potentially provide a safe insight to the jury concerning whether the data can be trusted at face value, as long as the meaning remains "common sense" and does not move to a higher level of precision. Such knowledge may be gained by access to a formally assessed body of knowledge accepted by a wide body of experts detailing generic (non-case specific) uncertainties in the call data.

Scenario 2. The cellsite usage is all within a constrained area of London (all cellsites within 5 km of each other) over a specific period related to an offence. The practitioner producing the maps and tables is asked to describe or explain the data, specifically if the device moved from one general area of London to another

The question, at face value, is similar to that in scenario 1 (i.e. the practitioner is not explicitly asked to estimate the service area of any cell used, or whether they encompass areas including a location of interest) but the scale is different, and the times of the calls are related to specific scenarios.

The general expectation for cell service areas in suburban London is between 1 and 3 km, but there are common exceptions to this and it is by no means a "rule". The scale of the maps considered are therefore similar to the expected ranges of the cells used. As such, while there may be "common sense" aspects to a prospective answer (e.g. that the cells will serve parts of the general area in which they are based), there will be many scenarios that could account for the data at the scale presented, and there is an obvious implication that the practitioner is being drawn into comment at a level of precision requiring a wider set of knowledge and understanding than in scenario 1. No matter how many maps and tables have been generated by the practitioner in their career, this experience alone will not provide any additional knowledge than that of a juror in, for example, assessing cell service areas, so additional skills (e.g. surveying), knowledge (e.g. cell selection, network operation etc.) and understanding (assessing and expressing uncertainty in any findings, forming propositions, understanding the hierarchy of propositions and transposed conditionals etc.) may be required. Commentary may quickly cease to be common sense, may easily drift into expert evidence and opinion, and this may not be apparent to the practitioner or the court. If the findings are "opinion" the practitioner must have the skills, knowledge and understanding to safely do so and their findings should clearly be presented as such.

6.2. Example 2. Interpretation of survey data

Survey data can provide useful information to aid assessment of:

- Whether (or not) a cell served at a location of interest at the time of the survey
- The general area over which the cell also served at the time of the survey (a small cell is more discriminating as to where the device may have been than a large cell)

Survey methods are essentially a form of experiment, and the measurements are prone to uncertainty with issues potentially including repeatability, false positives and false negatives [1]. There is no industry-agreed "perfect" method for surveying, and different practitioners may use different methods.

Presentation of survey data could be perceived as "Technically Interpreted" as the process, while involving technical complexity, is sufficiently simple for a juror to follow. Issues can arise, however, when the data is used in conjunction with the Call Data and used to aid interpretation of it either as investigative or evaluative opinion (which is a logical expectation for use of survey data).

- If a cell of interest is detected as serving at a location it does not mean that the device must have been there. If the cell in the call data serving the location is large, the device could be many kilometres away and, unless the practitioner has estimated this area, they may not be aware of the (limited) precision of the finding. If another cell is used close in time to that measured at the scene and the second cell does not serve at the location, it implies that the device was in an area of overlap of the two cells and therefore could not have been at the location of interest even when using the cell that serves there in this instance. A wider understanding of the RF environment in the area of interest, and the context of cell usage within the wider call data, are therefore other factors that a practitioner should consider to safely interpret survey results in the context of call data
- If a cell of interest is *not* detected as serving at a location, it does not necessarily mean that it could not or did not serve, and that usage of it excludes a device from having been at the location. There may be a variety of reasons why a given cell was not detected as serving; For example the method used may not be sufficiently robust and prone to "false negatives"; the cell may be an overlaid cell on the same mast and with the same azimuth but using a different frequency not monitored by the equipment at the time of the survey; there may have been a network change since the time of the call and the time of the survey,

Additional activity may be required to establish whether it is reasonable that a given cell served (or did not serve) an area including a specific location at the time of a call, and this activity may include skills, knowledge and understanding beyond the skill required to use the survey equipment or process its output. If the practitioner interprets the meaning of the findings in the context of the case, they must be aware that this is potentially opinion evidence and be sure it is declared as such and they are competent to act in this role. Additionally, if a practitioner presents the survey results to a court with no interpretation but leaves others with no competence to do so (e.g. the jury), the court may be misled.

6.3. Example 3. Interpretation of calculations from call data

Two devices are alleged to have been used by the same person. The records of the devices of interest have been normalised and sorted in date/ time order: For those calls which cell information is provided the distance between the masts used in turn have been calculated, and the time elapsed between each of these call events, enabling the speed required to move between the cellsites used by each device in a straight

line to be calculated. This helps highlight whether there is data that may be in conflict with the proposition that the devices were together that requires more detailed consideration.

The analysis may on first view be perceived as “Technically Interpreted” as all of the data referred to is present in the CDRs and the calculations are sufficiently simple for a juror to follow. The interpretation of the results of these calculations, however, may require a range of skills, knowledge and understanding, as there may be many reasons why widely spaced cellsites may be used close in time to one another by the two devices if they are together.

For example, a cell's service area will extend from the mast location and cover an area, and some cells may be large. If a large cell is used by one device, and another large cell is used by the other device for the following call, there may be overlap some distance from the mast location of the cell used by each device. If the time between usage of the devices is short, and the mast separation is large, this may appear in the calculations as apparently in conflict with the expectation that the devices could be together. In reality no movement at all is required by the devices to be together if the cells overlap; It is the separation (or not) of the cells, not the masts, that is the critical consideration, and this requires additional activity than the first stage of comparing mast locations.

Safe interpretation of the meaning of the results may therefore require a broad range of skills, knowledge and understanding, and will usually result in the provision of opinion even though the underlying data is factual and the initial calculations simple.

7. Conclusions and recommendations

This paper has considered the activities of practitioners dealing with Call Data and the difference between presentation, explanation and interpretation – whether that interpretation be for Investigative or Evaluative purposes. It is the authors' view that there is a distinct difference in these roles and responsibilities, and that there is a need for the differences to be recognised and understood not only by the judiciary and forensic providers but also by practitioners themselves. It is important to reduce or eliminate those occasions where practitioners are asked, expected or indeed offer opinions on areas outside their expertise.

It is inappropriate and misleading to ask a witness presenting technical “fact” evidence to interpret results in the context of a case as additional knowledge and understanding may be required to do so safely and any answer will, by definition, be taken as “fact” by the jury when it may be opinion. It may be appropriate for a witness presenting technical evidence who is not accepted by the court as an expert to make comments based on “common sense”, the test for which is that the jury can reasonably be expected to understand the technical matters arising, there is no uncertainty in the judgment, and the limitations of the source data are known (i.e. the practitioner is competent to know this and has declared it).

It is also no longer possible to rely solely on the academic qualifications or experience of an individual as a basis of acceptance as an expert. There are competencies beyond purely technical skills and knowledge that are required to safely interpret data and posit opinion. Accreditation (unavailable at the time of writing) may address aspects of this, to ensure an appropriate competency framework is implemented and followed. Individual performance can also be assessed via Blind Trials, where the truth is known so that the expert's opinion can be calibrated against (a) the actual truth for accuracy and (b) other experts for precision. As always, the judiciary have a key role to play by recognising and critically reviewing the process by which the areas and type of expertise being provided by the witness is determined.

Forensic Providers (organisations within which practitioners work, e.g. private companies or law enforcement agencies) can equip their practitioners with the appropriate training and support if they themselves appreciate the differences and limitations within the roles. It is incumbent upon all practitioners that they fully understand their role, its scope and limitations.

Declaration of competing interests

None.

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